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ABSTRACT

This study evaluated the effectiveness of drawing training on the paired-associate learning of lower- and middle-class kindergarten-age children where learning materials consisted of simultaneously presented pictures, successively presented pictures, or successively presented aural nouns. Subjects were 84 kindergarten children, half from two Title I funded schools serving low socioeconomic residential areas and half from two schools serving middle socioeconomic residential areas. In the training session, experimental groups were presented with pictures or nouns and asked to make a drawing of the two things doing something together; control subjects were asked to simply think of a picture of the two things doing something together. When learning was assessed by a recall method, it was found that there were no significant differences between training and control conditions for any of the three presentation modes. Performance of middle-class children surpassed that of lower-class children in the simultaneous picture and successive noun conditions. Comparisons between presentation modes showed simultaneous pictures significantly better than successive pictures, and simultaneous pictures significantly better than successive nouns, and that there was no significant difference between pictures and nouns when both were presented successively. (Author/SB)

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Technical Report 405

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Technical Report No. 405

THE EFFECT OF DRAWING TRAINING ON YOUNG CHILDREN'S
PAIRED-ASSOCIATE LEARNING AS A FUNCTION OF
SOCIOECONOMIC LEVEL AND MODE OF PRESENTATION

by

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Report from the Project on
Children's Learning and Development

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THE EFFECT OF DRAWING TRAINING ON YOUNG CHILDREN'S
PAIRED-ASSOCIATE LEARNING AS A FUNCTION OF
SOCIOECONOMIC LEVEL AND MODE OF PRESENTATION

Abstract

The purpose of the present study was to evaluate the effectiveness of drawing training on the paired-associate learning of lower- and middle-class kindergarten-age children where learning materials consisted of simultaneously presented pictures, successively presented pictures, or successively presented aural nouns. When learning was assessed by a recall method, it was found that there were no significant differences between training and control conditions for any of the three presentation modes. Performance of middle-class children surpassed that of lower-class children in the simultaneous picture and successive noun conditions. Comparisons between presentation modes showed simultaneous pictures significantly better than successive pictures, and simultaneous pictures significantly better than successive nouns, and that there was no significant difference between pictures and nouns when both were presented successively.

CHAPTER I

Introduction

It has been suggested that individual differences in the success of learning may be related to differences in the private mental activities in which learners engage. The term "mental elaboration" was introduced by Rohwer (1967) to describe the tactics which are believed to characterize the mental operations employed by successful learners on associative learning tasks. Such tactics, involving the enriching or augmenting of the elements to be learned, are thought to have their effect by extending the meaning of the original material. One method used to investigate the relationship between elaboration and learning efficiency is the method of paired associates in which the task of the learner is that of associating pairs of discrete items in such a way that when one of members of each pair is presented, the other member can be recalled. A substantial number of studies support the conclusion that learners who perform effectively do produce elaboration and that such elaboration improves learning efficiency.

The effects of elaboration have been examined with respect to both the nature of the strategy and the method

of strategy evocation. Elaboration may be accomplished by verbal strategies involving the generation of a sentence context for each pair and by imagery strategies involving a thematic visual image for each pair. The method of evocation in either strategy may be imposed or induced (Levin, 1972). An elaborative strategy is said to be "imposed" when materials are presented to the learner already embedded in a meaningful context. A strategy is "induced" in learners when the learner is provided with an instructional set to generate his own elaboration for the to-be-learned material.

One approach to the facilitation of associative learning performance lies in the possibility of presenting learners with enriched learning materials (imposed elaboration). However, Levin (1976) has argued that since the majority of everyday learning situations are less than optimally structured, in order to process the to-be-learned material effectively the learner must be equipped with organizational strategies that will free him from the typically impoverished quality of incoming stimuli. Research comparing the effects of self-generated elaboration to that of imposed elaboration (Danner & Taylor, 1973; Kerst & Levin, 1973; Wolff, Levin & Longobardi, 1974) further suggests the importance of the learner's active

participation in the learning process.

Instructional training techniques have proved successful in facilitating the associative learning of adults (Bower, 1972; Yuille & Paivio, 1968). Recently, there have been attempts to develop an effective procedure for training self-generated imagery elaboration in young children. The results obtained by Varley, Levin, Severson, and Wolff (1974) and Yuille and Catchpole (1973) indicate that kindergarten-age children can be trained to generate imagery to enhance their learning of concrete-object paired associates. The objective of the present study is to investigate the possibility of training kindergarten-age children to generate imagery elaboration in response to the less concrete materials, such as pictures and aurally presented words, which more closely approximate the stimuli characterizing everyday school learning experiences.

CHAPTER II

Review of the Literature

Visual Imagery and Learning

The results of research in the past several years suggest that visual imagery constitutes a useful organizational strategy in associative-learning tasks (Levin, 1976). However, the benefits derived from such an experimenter-induced organizational strategy appear to be a function of a number of subject- and task-related variables. One variable identified is the cognitive maturity of the learner. While older children can benefit from covert imagery instructions (e.g., Levin & Kaplan, 1972; Wolff & Levin, 1972), children younger than 6 or 7 years of age are typically unsuccessful when requested to generate an imagery elaboration strategy independently (e.g., Eoff & Rohwer, 1972; Montague, 1970; Wolff & Levin, 1972). Such findings are viewed as being consistent with the work of Piaget and Inhelder (1971) which suggests that it is not until the onset of the stage of operational thought (at about 7 or 8 years) that the child is capable of moving beyond the imagining of a static, perceptual copy of the to-be-associated items to the manipulation of images necessary for anticipatory image production. Piaget's theory of cognitive development further suggests

that covert imagery formation is based in the motor imitative activity of the child. The covert carrying on of activities necessary for visual imagery is conceptualized by Piaget as internalized imitation, evolving from the child's early play and imitation. It has therefore been reasoned that overt activity might mediate the formation of an internalized dynamic image of the to-be-associated items. In accordance with these assumptions, a number of studies have demonstrated that the paired-associate (PA) learning of young children may indeed be facilitated by providing them with relevant, concurrent motor activity. In a study reported by Wolff and Levin (1972) it was found that the PA learning of children as young as 5 years was facilitated when subjects were allowed to manipulate the to-be-associated object pairs (children's toys) even in the absence of visual feedback. Under such conditions, the associative learning of kindergarten subjects approached the level of non-motor, imagery performance of third grade subjects assumed to be functioning at the operational level. The centrality of overt motor activity is assisting young children to generate their own elaboration during PA learning is further suggested by Wolff, Levin and Longobardi (1972) who found that the rated quality of subject-produced manipulations and subsequent learning

were lowered by the absence of tactual acontact with the objects but not by the absence of visual feedback.

Elaboration Training and Children's Associative Learning

The primary focus of the present study concerns the training of young children in the generation of their own imagery elaboration for unelaborated stimulus materials. While early attempts to train young children in elaboration strategies proved disappointing (Rohwer & Ammon, 1971; Rohwer, Ammon & Levin, 1971) more recent attempts in this direction have emphasized motor involvement in imagery training with encouraging results. Danner and Taylor (1973) trained first, third, and sixth grade children in the generation of relational imagery for pictorial triplets. During the training phase, subjects were shown three separated pictures of nouns and were required to generate and draw an interactive or spatially contiguous scene incorporating the three objects; subjects were then asked to describe verbally the relations depicted in their drawings and were subsequently given practice test trials using a recall method. In the experimental task, subjects were shown fifteen pictorial sets of separate, unrelated objects and told to think of a picture of the three things doing something together. When learning was assessed by a recall test, it was found that even first grade children were able to effectively utilize

drawing training in relational imagery. Thus, the Danner and Taylor findings support the Wolff and Levin (1972) conclusions regarding the relationship between motor activity and imagery production and extend the findings of the latter study in demonstrating that young children are capable of dynamic imagery generation in the absence of concurrent motor activity and that such imagery generation can be trained in children as young as first grade, even where stimulus materials are pictorial.

A study reported by Varley, Levin, Severson and Wolff (1974) compared the effect of two types of motor training (playing and drawing) on the subsequent use of an imagery strategy in kindergarten and first grade children. Stimulus materials consisted of concrete objects (toys), eight pairs of which were used in the training phase and fifteen pairs of which were used in the study-test phase. Using a semi-rural, middle-class sample, Varley et al. assigned subjects to one of five training conditions. In the imagery control condition, subjects were shown a predetermined interaction for each for the first four training pairs and instructed to imagine an interaction for each of the four remaining pairs. The imagery control condition was thus a non-motor condition against which the four motor training conditions could be compared.

In the Repeated Play and Repeated Draw conditions, subjects were instructed to generate interactions for each of the eight training pairs either by playing with the toys or by drawing the toys in some form of interaction. In the Faded Play and Faded Draw conditions, subjects demonstrated interactions for the first four training pairs either by playing or by drawing as in the Repeated-motor conditions; in order to provide practice in generating imagery apart from motor activity on the last four pairs, subjects were required to indicate that they had generated an imaginal interaction before they were allowed to execute it through playing or drawing. At no time were the objects labeled by the experimenter or by subjects. The criterion-list pairs, presented by way of an incidental-learning format, were learned in the absence of motor activity. When learning was assessed by a recognition test, it was found that within the kindergarten sample each of the four motor training conditions resulted in significantly better learning than the imagery control condition. Within the first grade sample, there were no significant differences between control and motor training conditions.

The Varley et al. findings thus extended previous research by demonstrating that even in children as young as kindergarten age, training can be effective in separating

motor involvement from imagery production and that drawing training can be effective even at this age level. That playing and drawing conditions did not differ statistically in producing improved PA learning was interpreted as providing support for Piaget's contention that both playing and drawing represent vehicles for visually internalizing external stimuli.

In further examining the relationship between self-generated imagery and motor activity, Bender and Levin (1976) conclude that kindergarten children appear to be able to generate an image in the planning which precedes a motor activity, without prior training in motor manipulation and clearly without the actual execution of the activity.

Social Class Differences in Associative Learning Efficiency

A second issue of concern regards the possible effectiveness of training in remediating the deficiencies in elaborative skills of low socioeconomic status children relative to their middle-class counterparts. Although social class differences are smaller on tests of "new learning" (e.g., paired associates) than on tests which depend on past learning (e.g., intelligence tests), such differences frequently emerge among children below the age of 7 years. Of interest here are studies reporting socioeconomic class differences in the associative learning

performance of pre-school and kindergarten age children in which obtained differences favor the higher strata children (Rohwer, 1967; Rohwer, Ammon, Suzuki & Levin, 1971; Semler & Iscoe, 1963).

Rohwer (1967) has hypothesized that differences in the degree of spontaneous mediational activity in which children engage may account for the socioeconomic status discrepancies observed in PA learning. However, Rohwer and Levin (1971) have reviewed studies indicating that the PA learning of upper-class children surpasses that of lower-class children even when imposed elaborative prompts are available. If, as suggested by Rohwer and Levin (1971), a distinction is made between the production and use of elaboration by individuals or groups, such findings suggest that in addition to differences in the spontaneous generation of elaboration, children of different socioeconomic groups may differ in their ability to benefit from even maximally facilitative learning materials. It may be that some children may need to learn how to profit fully from imposed elaboration. Jensen (1966) has suggested early training in elaborative skills as one possible aspect of compensatory education.

There is some evidence to indicate that the emergence of social class differences in PA learning efficiency

varies significantly with the method of presenting learning materials (Rohwer et al., 1971). Moreover, training procedures designed to remediate the apparent deficiencies in elaboration skills of lower strata children have suggested that differences among item types may have a more pronounced effect on learning efficiency than certain types of training experiences (Rohwer & Ammon, 1971).

Presentation Mode and Associative Learning

A third variable which appears to affect the PA learning of young children is the medium in which learning materials are presented. It has been noted that when children are presented with materials which are not in themselves highly concrete the facilitative effect of imagery instructions is less pronounced (Eoff & Rohwer, 1972; Levin & Kaplan, 1972). In comparing verbal and pictorial presentation of items, numerous studies have indicated that higher levels of performance are associated with pictures than with words (Dilley & Paivio, 1968; Levin, Davidson, Wolff & Citron, 1973; Rohwer et al., 1971; Rohwer, Kee & Guy, 1975; Rohwer, Lynch, Levin & Suzuki, 1967). Similarly, Levin (1972) has observed that where imagery instructions have failed to improve children's learning the stimuli have typically consisted of verbal materials.

Such findings are essentially consistent with the work of Paivio and his associates who have reported a substantial amount of evidence related to the properties of paired-associate items (Paivio, 1969, 1970, 1971). In a series of studies it has been shown that nouns rated high in imagery-arousing potential are easier to learn than low-imagery nouns in paired-associate learning tasks. Likewise, concrete nouns exceed abstract nouns in their capacity to evoke images and are easier to learn as paired associates than abstract nouns. Paivio hypothesizes that the superior effect of stimulus term concreteness, in particular, is due to the prior association with referent objects which therefore evokes sensory images to mediate response recall. The abstract - concrete dimension of stimulus meaning can be extended to include objects and pictures of objects; the reasoning is that just as concrete nouns evoke imagery more readily than abstract nouns, so objects or their pictorial representations evoke imagery more readily than concrete nouns. Supporting this line of reasoning are studies which have found object pairs easier to learn than picture pairs (Iscoe & Semler, 1964) and picture pairs easier to learn than concrete noun pairs (Epstein, Rock & Zuckerman, 1960). Such research suggests that the facilitative effect of objects or pictures relative

to concrete nouns is analogous to the effect of concreteness varied at the verbal level.

A number of the successful attempts to train kindergarten -age children in imagery strategies have employed concrete objects (toys) as the stimulus material in PA learning tasks (Varley et al., 1974; Yuille & Catchpole, 1973). However, as objects are regarded as more concrete and likely to evoke dynamic images more readily than the pictures and words used in previously unsuccessful training studies with kindergartners (Rohwer & Ammon, 1971), it appears that even though children may benefit from an imagery strategy under certain conditions (e.g., when the stimuli are objects) they may not benefit under other conditions (e.g., when the stimuli are words).

Previous training studies employing concrete objects or pictorial item types have typically presented pair members simultaneously and have, in addition, generally provided subjects with physically present stimuli during assumed imagery formation processes. In the case of aurally presented nouns (without concurrent printed representation) pair members have necessarily been presented in a successive, rather than simultaneous, manner. The unique aspects of auditory and visual presentation thus confound the effects of stimulus concreteness with the effects of temporal contiguity.

Nodine and Goss (1969) note that despite the status of the law of contiguity within the framework of classical associationism and current theoretical considerations of learning, there is little empirical evidence which bears directly on it. Guthrie (1933) cites Robinson who, in reformulating the law of contiguity, proposed that the strength of an associative connection is a continuous function of the time interval between "instigating" (stimulus term) and "instigated" (response term) items, being maximal when such items coincide in time. However, comparing the characteristics of Robinson's learning curve with the very different curves yielded by other data, Guthrie (1933) concludes that the key to the discrepancies in findings lies in the nature of the intervening activity and hypothesizes that association must depend on mediating items and on the opportunity for simultaneous association offered by an overlapping of actual stimuli and the actions which function as stimuli.

Reviewing studies which used adults as subjects in making comparisons between simultaneous and successive presentation of stimulus and response terms (Kopstein & Roshal, 1955; Mueller & Travers, 1965; Mueller, Van Mondfrans, Chan & Travers, 1966; Van Mondfrans & Travers, 1965), Nodine (1969) points to the superiority of

simultaneous presentation relative to successive presentation as evidence of the importance of the contiguity factor. However, in comparing simultaneous with successive presentations of varying intervals between stimulus and response terms (I(S,R)), Guthrie (1933) found that PA performance was significantly higher at the longer intervals than either simultaneous presentation or short intervals and concludes that higher associative strength in the longer intervals may have been due to uncontrolled practice and was undoubtedly related to intervening activities. Using a successively presented aural PA task, Martin and Schulz (1963) obtained a similar pattern of results. That studies in which subjects were instructed to avoid rehearsing (Frceberg, 1918: Experiment 1) or were required to engage in a task precluding rehearsal (Martin, 1966) showed an invariant level of performance as I(S,R) increased suggests more directly the probable importance of intervening activity during I(S,R). Nodine (1969) proposes two factors which describe the relationship between I(S,R) and response strength. A model of the interaction of contiguity and rehearsal components indicates that the influence of temporal contiguity decreases rapidly from 0 seconds to 1 second and remains relatively constant up to at least 6 seconds I(S,R).

Beyond 1 second, the influence of the rehearsal component increases in a negatively accelerated fashion, compensating for the loss in temporal contiguity.

While Alworth (1974) has compared the simultaneous and successive presentation of symbol - number pairs with children and Bruininks (1972) reports a pilot study comparing the simultaneous and successive presentation of picture pairs with children (discussed in Chapter V), it does not appear that imagery studies comparing aural and pictorial item types have treated temporal contiguity directly as an independent variable in evaluating the efficacy of these two item types in the PA learning of young children.

Statement of the Problem and Hypotheses

The purpose of the present study is first to investigate the generality of the Varley et al. (1974) finding of the effectiveness of drawing training for kindergarten-age children by extending the range of learning materials to the less concrete media of pictures and words. The study will also attempt to evaluate the effect of stimulus materials of varying degrees of concreteness on lower- and middle-class children's ability to profit from drawing training. Generally studies comparing pictorial and aural item types in children's PA learning have presented pictures simultaneously and

aural nouns successively. In order to separate the effects of stimulus concreteness from the effects of temporal contiguity, a third mode of presentation, successive pictures, will be introduced. Comparisons between the simultaneously and successively presented pictures and between pictures and nouns presented successively will attempt to clarify whether it is the degree of concreteness or differences in method of presentation which accounts for the demonstrated differences of visual and aural item types in PA learning efficiency.

As it has previously been demonstrated that for kindergarten-age children motor training procedures resulted in better learning than non-motor, imagery control conditions, it is anticipated that the performance of children in the training conditions will surpass that of children in the control conditions. Previous training studies have demonstrated that young children are able to benefit from drawing training in learning tasks which involve concrete objects and have suggested the centrality of motor involvement in imagery training strategies at this level of cognitive development. While some unsuccessful training studies have employed less concrete materials, they have also not exploited fully motoric involvement as a vehicle for internalizing external stimuli. A training

procedure which does incorporate motor involvement as the dominant feature might be expected to result in an improved level of performance in the learning of pictorial and aural materials at the kindergarten-age level. However, the facilitative effect of an imagery strategy seems likely to vary to some degree as a function of the concreteness of the material presented, with most pronounced facilitative effects likely to emerge in response to the more concrete stimuli when pair members are presented simultaneously. Finally, it is anticipated that the present training procedures will be effective for subjects of both socioeconomic levels. Previous attempts to train high and low strata second graders have found that training effects were confined to high strata children (Rohwer & Ammon, 1971). It is hoped that the motorically-oriented training of the present study will shed further light on possible means of raising the performance of lower strata children even given the presumed most difficult aurally presented material. If successful, the Varley et al. (1974) speculation about the likely generality of drawing as an imagery-training strategy will be confirmed.

Method

Subjects

Eighty-four children attending kindergarten classes at four public schools in a midwestern city served as subjects. The number of subjects participating in the study was determined by school-schedule subject availability rather than by experimental considerations. One-half of the subjects were drawn, in equal numbers, from two Title I funded schools one of which served a predominantly low socioeconomic black residential area and one of which served a predominantly low socioeconomic black and white residential area. The remaining half of the subjects were drawn, in equal numbers, from two schools which served predominantly middle socioeconomic white residential areas.

An approximately equal number of boys and girls participated in the study. Subjects ranged in age from 5 years 7 months to 7 years 3 months with a mean age of 6 years 1 month. The mean ages for the lower and middle socioeconomic samples were approximately equal, 72.8 months and 72.4 months, respectively. Children suspected by their teachers of being mentally retarded and/or emotionally disturbed were eliminated from the subject pool. Children from homes in which English was not the primary language spoken were likewise excluded from the

subject pool. One boy, whom it was subsequently learned had never been heard to speak, was dismissed by the experimenter prior to beginning actual training procedures. All other subjects were able to complete training and testing procedures.

Design

The factors in the 2 x 2 x 3 design were populations (middle socioeconomic, low socioeconomic), treatment (training, control), and mode of presentation (simultaneous pictures, successive pictures, successive nouns). Children from each of the two populations were randomly assigned, in equal numbers, to one of six experimental conditions: training with simultaneous pictures (t-SiP), training with successive pictures (t-SuP), training with successive nouns (t-SuN), control with simultaneous pictures (c-SiP), control with successive pictures (c-SuP), control with successive nouns (c-SuN). There were thus 7 subjects in each of the 12 cells.

Materials

Training and criterion lists involved 46 objects which were represented either pictorially or aurally depending upon the condition to which subjects were assigned. With seven exceptions, training and criterion list objects were identical in content to the actual objects (common children's toys) used in the Varley et al.

(1974) study. After initial pilot testing using the Varley et al. lists, the seven substitutions were made to accommodate pictorial and aural modes of presentation (e.g., "coffee pot" replaced the possibly aurally-ambiguous "pitcher") and the demonstrated vocabulary differences between Varley et al.'s rural population and the urban population of the present study. The 46 photographed objects used in the present study were all found to be easily labeled by inner city kindergarten children during final pilot testing.

The eight pairs used for training were those used for training in the Varley et al. study. The pairs were originally formed so that objects having the most plausible interaction potential were paired together (e.g., dog and car). However, objects having a high verbal association value (e.g., dog and cat) were not paired together.

Varley et al.'s fifteen pair criterion list, with the modifications described, served as the experimental list. The randomly formed pairs excluded combinations for which no plausible interaction or too obvious an interaction existed. The fifteen study pairs were presented in the same order for all subjects which was a different random order than that in which the fifteen test pairs were presented. The randomized orders were subject to the

constraint that at least two pairs intervene between the study and test exposures for any given pair. The eight training pairs and fifteen experimental pairs are shown in Appendix A.

Three forms of the list, parallel in content, constituted the actual task stimuli. Form one consisted of simultaneously presented pair members which were comprised of photographs of small, common children's toys (toy wristwatch, giraffe). Form two consisted of successively presented pair members which were comprised of the form one photographs. Form three consisted of successively presented pair members which were comprised of aurally presented nouns corresponding to the objects depicted in form one.

The picture conditions utilized a single set of 4" x 5" color photographs mounted on 6" x 7" cards. Each photograph depicted one of the 46 objects at rest against a plain background.

The experimenter-provided drawings, depicting an example of interaction for each of the first four training pairs, consisted of one set of simple pencil-line figures on 8½" x 11" white mimeo paper. In the training conditions, drawing materials consisted of a primary-school pencil without eraser and one sheet of 8½" x 11" white mimeo paper for each of the eight pairs to be drawn.

Procedure

Each subject was tested individually in a small, separate room during regular classroom periods. One experimenter conducted all training and testing procedures. A second experimenter recorded subject responses and, in picture conditions, re-ordered stimulus materials in order to eliminate any delay between the final study- and the initial test-item presentation.

Upon entering the experimental room, subjects were introduced to the second experimenter who was then stationed out of subjects' line of vision. Subjects were seated at a small table directly across from the primary experimenter during training and testing. In the picture conditions, pictures were kept in a box with the lid placed on end to prevent subjects from seeing the pictures before they were presented.

Training and control procedures were adapted from the Varley et al. (1974) Faded Draw and Imagery Control conditions, respectively. Modifications were made to accommodate the stimulus materials (pictures, nouns) and modes of presentation (simultaneous, successive) of the present study. In all conditions, the type of stimulus material and the mode of presentation were constant for each individual subject throughout training/control, study and test presentations.

Subjects in all six experimental conditions were

shown the eight training pairs which provided practice in generating interaction between pair members either by drawing (training conditions) or by imaging (control conditions).

Following Varley et al., the interactions depicted in subjects' drawings and in experimenter-provided drawings were described by the experimenter (e.g., "it looks like this one is chasing her"). However, pair members were not labeled by the experimenter. All subject verbalizations regarding list items, including attempts to label, whisper rehearsals or describe interactions, were suppressed by the experimenter in order to avoid confounding drawing training effects with the effects of subject-generated verbalizations.

Training condition subjects were told either that they would be shown two pictures together (t-SiP), shown two pictures one after the other (t-SuP), or told the names of two things one after the other (t-SuN). For each of the first four training pairs, subjects were asked to make a drawing of the two things doing something together. If, after ten seconds, subjects were unable to produce a drawing or depict a recognizable interaction, the experimenter showed an example drawing of pair members interacting. Nearly all subjects needed to be shown at least one such example drawing. If the performance of

subjects was not improved by seeing the example drawing, the experimenter encouraged an interactive representation of pair members by suggesting that they be drawn touching each other; less than half of the subjects needed such a suggestion. For each of the remaining four training pairs, subjects were asked to indicate that they had generated a picture before being allowed to execute it through drawing. It was hoped that training subjects would thereby be given practice in generating imagery independent of actual motor activity. If, after ten seconds, subjects did not have an idea of how pair members might interact, they were allowed to begin drawing in hopes that the act of drawing would evoke such an idea. If subjects were still unable to depict an interaction, the experimenter offered a verbal suggestion; less than one-fourth of the subjects needed a verbal suggestion on any of the last four training pairs.

Control subjects were told either that they would be shown two pictures together (c-SiP), shown two pictures one after the other (c-SuP), or told the names of two things one after the other (c-SuN). For each of the first four training pairs, subjects were shown the experimenter-provided sample drawing depicting the pair members in some form of interaction. For each of the remaining four training pairs, subjects were asked to simply think of a

picture of the things doing something together; subjects were allowed ten seconds to generate such an image for each of the four final training pairs.

Following presentation of the final training pair in all six conditions, intentional learning instructions were given for the experimental task, in contrast to the incidental learning format of the relatively easier Varley et al. task where learning was assessed by a recognition, rather than recall, method. To encourage the facilitative effect of simply "planning" a motor activity (Bender & Levin, 1976) and to facilitate generalization from training to criterion task, drawing condition subjects were told, prior to the presentation of each pair, to think of a picture they could draw of the things doing something together. Control subjects were told, prior to the presentation of each pair, to think of a picture of the things doing something together. Transcripts of instructions for each of the six experimental conditions are contained in Appendix B.

Following the pacing-rate used in previous training studies with kindergartners (Varley et al., 1974; Yuille & Catchpole, 1973), the fifteen pairs which comprised the experimental list were presented to all subjects at a 10 second rate. However, the actual duration of stimulus exposure was a function of item type and mode of

presentation. Thus, in the SiP conditions, stimulus exposure time was 10 seconds per pair; in the SuP conditions, stimulus exposure time was approximately 3 seconds per item and 6 seconds per pair; in the SuN conditions, stimulus exposure time was approximately 1 second per item, 1 second between items, and 3 seconds per pair. While studies reported by Bugelski (1962) and Van Mondfrans and Travers (1965) have indicated that total time is more important to PA learning than time per pair exposure, Stubin, Heimer and Tatz (1970) note that Bugelski (1962) included time for the stimulus term and interval between terms in comparing total time between shorter and longer exposure conditions; a similar problem is present in the Van Mondfrans and Travers (1965) study comparing simultaneous and successive presentation modes. Since imaging and learning of an association cannot occur until both members of a pair are known, time used for exposure of the stimulus term and for the interval between stimulus and response terms cannot be considered time available for learning the association. Therefore, while exposure times in the present study were unequal, actual learning time was roughly equivalent in the successive conditions (SuP: 10" minus 3" = 7"; SuN: 10" minus 2" = 8"). Learning time in the simultaneous condition (10" per pair)

was equivalent to learning time in the Varley et al. study.

Immediately following presentation of the last study pair, subjects' learning was tested by a recall method. As each stimulus term was presented in the form of subjects' training and study tasks (picture, noun), recall of the response term was prompted by the question, "What went with the (Stimulus term)?" As previous research (Rohwer & Ammon, 1968; Rohwer et al., 1971) has suggested that the test-trial performance of children is facilitated by a slow (e.g., 4 seconds) rather than a fast (e.g., 1 second) pacing rate, subjects were allowed a maximum of 10 seconds in which to respond. All responses were recorded verbatim. The few items which were mis-labeled (identified by a label other than the label of consensus) were referred to an independent scorer for blind evaluation.

The total time for participation in the experiment averaged 11 minutes for control subjects and 26 minutes for drawing training subjects.

Results

Learning was defined as the total number of correct responses (maximum = 15) on the test trial. The means and standard deviations for each of the six conditions within each socioeconomic level are presented in Table 1. Raw data for the criterion measure are presented in Appendix C.

An analysis of variance was performed with treatments and socioeconomic levels nested within presentation modes (see Table 2). For the first main factor, mode of presentation (SiP, SuP, SuN), the analysis yielded a significant F ratio ($F(2,72) = 24.08$, $p < .001$). Pairwise multiple comparisons between presentation modes were made following Tukey's procedure ($\alpha = .05$). The difference between simultaneous and successive picture conditions was significant (mean for SiP was 8.82, mean for SuP was 3.21), and the difference between simultaneous pictures and successive nouns was significant (mean for SiP was 8.82, mean for SuN was 3.74), but the difference between successive pictures and successive nouns was not significant (mean for SuP was 3.21, mean for SuN was 3.74). Thus, successive presentation of stimuli resulted in fewer correct responses than simultaneous presentation of

Table 1

Mean Number of Correct Responses and Standard Deviations
for Social Classes as a Function of Conditions

Social Class	DRAWING TRAINING			IMAGERY CONTROL		
	<u>SiP</u>	<u>SuP</u>	<u>SuN</u>	<u>SiP</u>	<u>SuP</u>	<u>SuN</u>
Middle						
Mean	9.857	4.571	6.286	11.000	3.286	3.571
SD	4.30	3.55	4.72	1.41	1.89	3.78
Lower						
Mean	5.714	3.000	2.571	8.714	2.000	2.571
SD	3.82	3.37	3.15	3.30	1.91	3.15

Table 2

Analysis of Variance for Number of Correct Responses

Source	df	MS	F
Presentation	2	268.08337	24.0845**
Treatment in SiP	1	30.03571	2.6983
Class in SiP	1	72.32144	6.4973*
Treatment x Class in SiP	1	6.03571	<1
Treatment in SuP	1	9.14285	<1
Class in SuP	1	14.28571	1.2834
Treatment x Class in SuP	1	0.14285	<1
Treatment in SuN	1	12.89285	1.1582
Class in SuN	1	38.89286	3.4941
Treatment x Class in SuN	1	12.89285	1.1582
Error	72	11.13094	

* $p < .025$ ** $p < .001$

stimuli and there was no significant difference between pictures and nouns when both were presented successively.

No significant ($\alpha = .05$) simple effects of treatment were found within any of the three presentation modes. For simultaneous pictures, training subjects averaged 7.79 correct and control subjects 9.86; for successive pictures, training subjects averaged 3.79 correct and control subjects 2.64; and for successive nouns, training subjects averaged 4.43 correct and control subjects 3.07.

Examining the simple effect of socioeconomic status within each of the three modes of presentation, significant ($\alpha = .05$) differences emerged for simultaneous pictures ($t(72) = 2.55$, $p < .01$, one-tailed) and for successive nouns ($t(72) = 1.87$, $p < .05$, one-tailed). For simultaneous pictures, middle-class subjects averaged 10.43 correct and lower-class subjects 7.21; for successive nouns, middle-class subjects averaged 4.93 correct and lower-class subjects 2.57. Within the remaining presentation mode, successive pictures, social class differences did not reach the level of significance ($t(72) = 1.13$, $p > .20$). For successive pictures, middle-class subjects averaged 3.93 correct and lower-class subjects 2.50.

None of the within-modes interactions was significant ($\alpha = .05$).

CHAPTER V

Discussion

The results of the present study did not support the main hypothesis that children receiving drawing training would show a higher level of performance on a subsequent PA task than children in imagery control conditions. A further delineation of the first hypothesis, that children of both socioeconomic levels would benefit from training procedure, was also not supported. Across treatment conditions, when social class levels were compared within presentation modes, the superiority of middle-class children relative to their lower-class counterparts emerged for the simultaneous picture and successive noun conditions. The third hypothesis, that more concrete materials presented simultaneously would be easier to learn than less concrete materials presented successively, was supported. Post hoc comparisons among presentation modes showed successive presentation, at both levels of stimulus concreteness, inferior to simultaneous presentation.

Discussion of Simultaneous Picture Conditions

When the results of the present study are compared to the Varley et al. (1974) data, it appears that the failure to obtain a training effect in the SiP condition of the present study was due not to the ineffectiveness of

training procedures but rather to the ability of children in the SiP imagery control conditions to perform at a particularly high level without the benefit of motor training.

The mean score for Varley et al.'s middle-class kindergarten sample in the Faded Draw condition was 10.12 while the mean score of middle-class kindergartners in the corresponding condition (SiP) of the present study was 9.85; however, while Varley et al.'s imagery control kindergartners obtained a mean score of only 6.00, the middle-class SiP imagery control kindergartners of the present study obtained a mean score of 11.00. The implications of this contrast become more striking when it is recalled that while the two studies sampled children of comparable age (Varley et al.: median age 6-1; present study: mean age 6-1), the experimental task of the present study was presumably more difficult than that of the Varley et al. study in substituting pictures for concrete objects and in utilizing a recall rather than a recognition test method. Although a direct comparison across studies cannot be made, the data suggest that the (SiP) control kindergartners of the present study (spring of 1976) receiving only exposure to experimenter-imposed elaboration were able to perform as adequately as the drawing condition kindergartners

sampled by Varley et al. in the spring of 1972. In terms of both the overall level of performance and the absence of training effects, the performance of (SiP) kindergartners in the present study was closer to the performance of the first graders (mean for Faded Draw was 9.00; mean for control was 8.43) than to the kindergartners in the Varley et al. study.

Such findings are not inconsistent with some recent data which indicate the occurrence of a cohort change presumed to reflect an acceleration of cognitive development in young children. Reese (1974) points to the broadcasting of "Sesame Street" and concurrent social and environmental changes beginning about November, 1969 as marking a period of change in the ability of preschoolers (age 4 - 6) to learn paired associates and in the ability of younger preschoolers (age $2\frac{1}{2}$ - $3\frac{1}{2}$) to utilize imposed pictorial elaboration. Comparing the two age groups and their performance before and after the change, Reese estimates that to the extent utilization of imposed elaboration reflects a change in cognitive skills, the younger preschoolers' level of functioning reflects a developmental acceleration of one to two years. Similarly, whereas the 4 - 6 year old children had been able to utilize imposed elaboration prior to the change, they no

longer needed imposed elaboration after the cohort change. The results of several recent unpublished studies lend further support to the finding that children of the age sampled in the present study are able to utilize an imagery strategy in PA tasks without experimental training procedures (Levin, personal communication, June 1976).

When two of the four teachers of the children in the present study were interviewed (one lower-class and one middle-class school), both reported an increased emphasis in the past few years on the formal teaching of reading readiness skills. Both teachers also reported the use of a particular classroom game in which one object is removed from (or re-located within) a series of objects while a given child does not watch; upon re-inspection of the series, the child must then identify (by visualizing the original series?) the missing or re-located object. The continuing influence of television programs designed to improve cognitive skills together with a reportedly increased emphasis on reading skills and cognitively-oriented classroom games may help account for the apparent ability of the kindergartners sampled to learn paired associates without motor training.

It may be worthwhile to note two other factors which

may have operated to attenuate differences between training and control groups, particularly in the SiP condition. The first of these is related to the relative proportions of induced and imposed imagery that characterized the training phase for each individual subject. As the experimenter-provided sample drawings (imposed imagery) were shown to training condition subjects only when they were unable to independently depict an interactive scene, it was possible that a training subject might be exposed to no imposed imagery. Subjects in the t-SiP condition, having both items before them as they drew, may have experienced less difficulty and therefore been exposed to fewer experimenter-provided drawings. On the other hand, all control subjects were shown four well-formed sample interactions during the training phase. In the Wolff and Levin (1972) study experimenter-produced elaboration resulted in a somewhat (though not statistically significant) better performance than subject-produced elaboration giving rise to the speculation that differences in the quality of elaboration may affect degree of facilitation. When such differences in quality were controlled for in a study by Wolff, Levin and Longobardi (1974), there were no imposed - induced differences upon immediate testing and differences which

avored an induced elaborative strategy upon testing after a 24 hour delay.

The second factor of interest concerns the possibility that under some conditions drawing may have served to distract the subject from the essence of the interaction he had set out to depict. While drawing and playing may indeed both represent vehicles for visually internalizing external stimuli, the utilization of playing skills, perhaps by being more firmly established in the behavioral repertoire of kindergartners, may require less intentional effort than the utilization of drawing skills. It appeared that some children devoted considerably more effort to drawing details of the individual pair members "correctly" than to the relationship between pair members. The SiP condition in particular may have exacerbated subjects' tendency to focus on the mechanics of drawing by providing a physically present model to "copy."

Discussion of Social Class Effects

Interpretation of social class effects is made difficult by the lack of comparability of results between schools within each socioeconomic level. When the mean score for each of the four schools was computed, it was found that for the two middle-class schools, the means for School M₁ and School M₂ were 5.61 and 7.23, respectively;

for the two lower-class, Title I funded schools, the means for School L₁ and School L₂ were 2.57 and 5.61, respectively. It may be of interest to note that while 17 of the 21 subjects from School L₁ were white, all 21 subjects from School L₂ were black. The mean score for lower-class white subjects (N = 17) was 2.05 and the mean score for lower-class black subjects (N = 25) was 5.48. In informal observations of the subjects from the predominantly white lower-class school it was noted that children were less apt to know their last names or ages and seemed to have more difficulty in understanding what was expected of them; informal review of response data from School L₁ shows a considerably higher frequency of extra-list errors (e.g., common associations) which may further suggest difficulty in task comprehension. While an explanation for the lack of comparability between the two Title I funded schools is clearly beyond the scope of presently available information, it is tempting to speculate that apparent differences in intellectual functioning may correlate with urban residential patterns. Since the majority of black children do attend inner city schools one might expect a more normal distribution in levels of intellectual functioning than in an inner city white population where the distribution may be somewhat skewed.

Given the lack of comparability associated with the four schools sampled, a post hoc analysis of variance was performed with schools (rather than social class levels) and treatments nested within presentation modes. The results obtained were essentially the same as those reported using social class as a factor. That learning efficiency did not vary as a function of social class (and schools) for successive pictures, among the most difficult of the three presentation modes, may reflect restrictions in the measuring of actual learning differences. The relative difficulty of the experimental task, reflected in the positive skew of the total distribution, suggests that an inadequate task floor may obscure differences at the lower end of the range of scores, perhaps particularly in the c-SuP condition where the scores show least variability. A shorter list or an assessment procedure such as trials to criterion might clarify the extent of the learning efficiency differences contained in the zero-correct scores, the modal score in the overall distribution.

When the superiority of middle-class children's learning in the SiP condition is considered with the suggestion that middle-class children also surpass their lower-class counterparts in the SuN condition, there is the

possibility of an alternative interpretation. It may be that when item and presentation types are consistent with the typical method of receiving information (spatially and temporally contiguous in vision, sequential in audition), middle-class children tend to learn more efficiently than lower-class children; however, when there is a departure from the usual method of receiving information (sequential vision), children of both social classes may be at an equal disadvantage. Such an interpretation, essentially consistent with the finding that tests dependent on past learning (e.g., intelligence tests) are more sensitive to social class differences than tests of "new learning," raises the question of the role of practice or prior experience with different modes of presentation in children of varying social classes.

Discussion of Simultaneous and Successive Modes

The finding that simultaneously presented picture pairs were learned more readily than successively presented aural nouns is consistent with the results of previous research. However, the additional finding that pictures were superior to nouns only when pictures were presented simultaneously suggests that previous hypotheses which explain picture superiority (relative to aural nouns) in terms of stimulus concreteness may need to be modified.

The superiority of the simultaneous condition in facilitating the learning of pictorial items when stimulus concreteness was held constant (SiP vs. SuP), together with the finding that pictures and aural nouns did not differ when both were presented successively, suggests that, at least for kindergarten-age children, mode of presentation may be more crucial than degree of stimulus concreteness (varied at these two levels) in associative learning tasks.

It will be recalled that in the SiP condition children receiving only exposure to imposed elaboration examples were able to learn as efficiently as children receiving drawing training. In referring to Figure 1, it can be seen that even with training children in the successive conditions appear generally to have been less successful in utilizing an imagery strategy than children in the simultaneous condition. If, as Reese (1974) hypothesizes on the basis of children's simultaneous picture PA learning, a cohort change reflecting an acceleration in cognitive development has enabled children of this age to utilize an imagery strategy without prior training, it appears that the effectiveness of such skills is greater under some conditions (e.g., SiP) than under other conditions (e.g., SuP, SuN).

The ease with which the condition of simultaneity lends itself to a meaningful linking of pair members is noted by

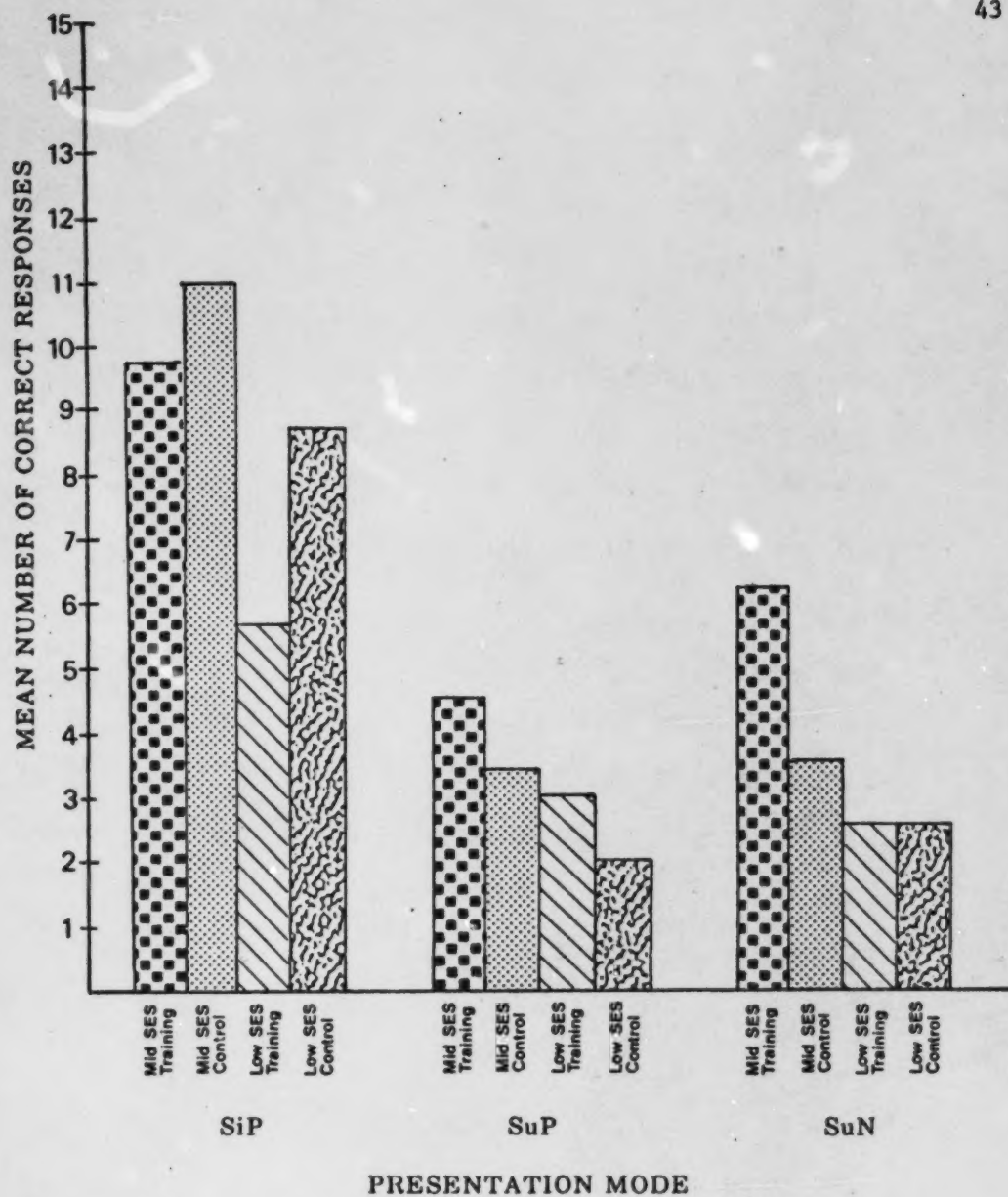


Figure 1. Mean number of correct responses for presentation modes as a function of treatments and socioeconomic levels.

Froeberg (1918) who, after instructing subjects to avoid all forms of rehearsal, found that in contrast to successive conditions, subjects in the simultaneous condition reported a persistent difficulty in inhibiting the tendency to form nonsense-syllable pair members into known-word approximates. The possibility of such a tendency of the condition of simultaneity to elicit meaningful associations may have contributed to the apparent ease with which pairs in the SiP conditions were learned.

In the successive conditions, the hypothesized acceleration in cognitive development resulted in relatively less successful learning. It may be that even where children are capable of dynamic imagery generation, a lack of facility in more basic aspects of task performance may interfere with the manifestation of these abilities on actual criterion measures (Brody, Kratochwill, Stone & Levin, 1976). In terms of the present findings, it may be that while children of the age sampled no longer need motor training to benefit from an imagery strategy, when stimuli are not presented simultaneously they may need to be taught how to respond to successively presented learning materials. Present training procedures, the same in all conditions and aimed at

training the generation of imagery, did not include training in strategies for responding to successively presented stimuli. Nevertheless, if young children are unable to keep the stimulus term in memory until the response term is presented, a dynamic image of the pair members is clearly precluded, regardless of the child's capacity to generate such an image. Anecdotal data further indicate the likelihood of difficulty in retaining pair members. During training, a good number of children in the successive conditions said that they had forgotten one of the pair members, often the stimulus term, and asked to see (or hear) the pair again.

The obtained differences between simultaneous and successive modes of presentation may also be considered in terms of stimulus availability. Whereas in the SiP condition learning materials were physically present during assumed imagery formation processes, in the successive conditions following successive exposure learning materials were physically absent during the time allotted for imagery formation. Guthrie (1933) notes that even though two items may be presented simultaneously, they may not be attended to simultaneously. Nonetheless, in simultaneous presentations, particularly of the duration in the present and previous training studies (Danner & Taylor, 1973; Varley et al., 1974; Yuille & Catchpole,

1973) the two items remain physically available for reference during imagery formation processes. In contrast to pictures presented simultaneously, it may be that when pictures are presented successively to children of this age they function more like less concrete stimuli such as aurally presented nouns. Reese (1970) suggests that the effectiveness of imagery is related to the richness and detail of the stimulus materials which act to retard an hypothesized leveling process. It may be that when kindergartners are presented with stimulus materials which do not remain physically present during imagery formation processes, the benefits of the enriching details of pictures are neutralized, at least relative to the benefit derived when equally detailed or concrete stimuli remain available in simultaneous presentation.

Implications for Future Research

It appears that the factors which may have been involved in the failure to obtain a treatment effect in the simultaneous picture condition are different than those which may account for the failure to obtain a treatment effect in the successive conditions. In the successive conditions the apparent difficulty of keeping the stimulus term, in particular, in memory suggest that mediating activities such as rehearsal which might have acted to compensate for the loss in contiguity were

probably either not being used or were used ineffectively. In addition, it may be that the absence of physically present stimuli during assumed imagery formation limited the effectiveness of an imagery strategy. The relative contributions of each of these factors to the difficulty of learning successively presented pair members remains unclear. A worthwhile direction for future research might be to attempt to further separate the factors which have confounded comparisons of pictorially and aurally presented items by equating learning time between simultaneous and successive conditions, by controlling for short-term memory deficits through verbal rehearsal, and by comparing SiP performance when stimuli are physically present to SiP performance when stimuli are removed. Clarification of the factors likely to account for the presently indicated difficulty of learning successively presented paired associates may suggest the directions most fruitful for future training procedures aimed at teaching children to elaborate successively presented stimuli.

One investigation of the effects of simultaneous and successive presentation on the learning of pictorial pairs is reported by Bruininks and Clark (1972). After obtaining the usual picture over word effect, even where

exposure time was equated, Bruininks and Clark conducted a small pilot study ($N = 10$) to determine whether simultaneity of visual perception was responsible for picture superiority and found no significant difference between simultaneous and successive picture presentation. However, an important difference between the Bruininks and Clark (1972) pilot study and the present study may lie in the fact that the former sampled children ranging in age from first to third grade. At this level of development, more advanced cognitive skills, including those required in reading, may enable children to respond adequately to both simultaneous and successive modes while also enabling them to derive more benefit from pictures than from words in PA tasks.

A developmental trend in the relative efficacy of pictorial and verbal stimuli has been noted such that unelaborated picture pairs become easier to learn, relative to word pairs, with increasing age (Rohwer, 1970; Rohwer et al., 1975). The picture - word difference which increases through the school years has also been reported in young, pre-reading age children. However, present data suggest the possibility that when presentation modes are equated (both successive), picture - (aural) word differences do not emerge for kindergarten children.

Present findings also suggest the possibility that at least at a kindergarten, pre-reading level, mode of presentation may be more crucial than item type in associative-learning tasks. Whether the importance of presentation mode decreases during latency years with the concomitant development cognitive skills and whether these associated cognitive skills may enable item type to take precedence over presentation mode with advancing age are questions which await a systematic investigation of the effect of presentation modes at various developmental levels.

Educational Implications

The results obtained appear to have some implications for facilitating classroom learning. Inferring that learning occurred in the SiP conditions because the subject successfully generated an image of the pair members interacting, it appears that kindergarten children may be able to utilize an imagery strategy in learning simultaneously presented pictorial materials even without prior motor training when they are provided with examples of imposed, ready-made visual elaboration. The suggestion that a cohort change presumed to reflect an acceleration in cognitive development in young children may be related to the current influence of television programs such as

"Sesame Street" suggests the continuing potential of such techniques and those, such as cognitively-oriented classroom games, employed by teachers. It would seem useful and appropriate to attempt a further delineation of the variables characterizing the reported cohort change, including an evaluation of the generality of the cohort change within and between school districts.

The results of the present study also suggest that traditional concern with choosing pictorial over the less concrete aurally presented learning materials should be tempered by considerations of the way in which pictorial materials will be presented. The presentation of the to-be-associated materials in a spatially and temporally contiguous way, rather than, for example, in a flip-over, flash card format, appears to facilitate the learning of kindergarten-age children. When the to-be-associated materials must be presented successively, teachers may first need to direct their efforts toward strengthening the short-term visual and auditory memory abilities required when materials are not presented simultaneously.

Summary

The present study was designed to investigate the generality of the Varley et al. (1974) finding of the effectiveness of drawing training on the PA learning of kindergarten-age children by extending the range of learning materials to the less concrete media of pictures and aurally presented nouns. Using treatment procedures adapted from the Varley et al. (1974) Faded Draw and Imagery Control conditions, the present study attempted to evaluate the effects of stimulus materials of two levels of concreteness on lower- and middle-class children's ability to profit from elaboration training. Generally studies comparing pictorial and aural item types have presented pictures simultaneously and aural nouns successively. To separate the effects of stimulus concreteness from the effects of temporal contiguity, a third mode of presentation, successive pictures, was introduced.

Kindergarten children of each socioeconomic level (middle, lower) were randomly assigned to either a training or control condition utilizing one of three modes of presentation (simultaneous pictures, successive pictures, successive aural nouns). Subjects in control conditions were exposed to experimenter-provided drawings depicting an

example of interaction between pair members for the first four training pairs and were instructed to generate their own imagery for the last four training pairs. Subjects in training conditions drew pair members in an interactive scene for the first four training pairs and were required to indicate they had generated an image of pair members interacting prior to actual drawing of the interaction on the last four training pairs. At no time were items labeled by either subjects or the experimenter.

The experimental task stimuli consisted of three forms of a 15-pair PA list with items presented as simultaneous pictures, successive pictures, or successive nouns depending on the condition to which subjects had been assigned. The type of stimulus material and mode of presentation were consistent for each individual subject throughout training/control, study and test presentations. Following the presentation of each of the 15 experimental pairs, learning was assessed by a recall method and defined as the total number of correct responses on one test-trial.

When the data were analyzed with treatments and social class levels nested within presentation modes, it was found that there were no significant ($\alpha = .05$) differences between training and control conditions for any of the

three presentation modes. Performance of middle-class children surpassed that of lower-class children in the simultaneous picture condition ($t(72) = 2.55, p < .01$, one-tailed) and in the successive noun condition ($t(72) = 1.87, p < .05$, one-tailed). Pairwise multiple comparisons between presentation modes following Tukey's procedure ($\alpha = .05$) showed simultaneous pictures to be significantly better than successive pictures, and simultaneous pictures to be significantly better than successive nouns, and that there was no significant difference between successive pictures and successive nouns. None of the within-modes interactions was significant ($\alpha = .05$).

The failure to obtain a training effect in the simultaneous picture condition was attributed not to the ineffectiveness of training procedures but rather to the ability of the kindergartners in the (SiP) imagery control condition to perform at a particularly high level without the benefit of motor training. Such an interpretation of present findings relative to those obtained in earlier motor training studies was discussed in relation to evidence indicating a recent cohort change presumed to reflect an acceleration of cognitive development in young children. The failure to obtain a training effect in the

successive conditions was interpreted as possibly reflecting the operation of such factors as short-term memory deficits and the effect of the absence of the actual pair members during imagery formation processes. It was suggested that alternative or more extensive training techniques may be needed to assist kindergarten-age children in learning to generate imagery for successively presented materials. The finding that pictures resulted in better learning than aurally presented nouns only when pictures were presented simultaneously was interpreted as suggesting the possibility that, for kindergartners, presentation mode may be more crucial than the pictorial or aural characteristics of the learning materials in determining PA learning.

References

- Alworth, R.M. Audiovisual equivalence of stimuli in acquisition of associations at two reading levels. Perceptual and Motor Skills, 1974, 38, 1271-1274.
- Bender, B.G., & Levin, J.R. Motor activity, anticipated motor activity, and young children's associative learning. Child Development, 1976, 47, 560-562.
- Bower, G.H. Mental imagery and associative learning. In L. Gregg (Ed.), Cognition in learning and memory. New York: John Wiley and Sons, 1972.
- Brody, G.H., Kratochwill, T.R., Stone, S., & Levin, J.R. Imagery generation in young children's paired-associate learning: Competence or performance? Paper presented at the meeting of the Rocky Mountain Psychological Association, Phoenix, 1976.
- Bruininks, R.H., & Clark, C.R. Auditory and visual paired-associate learning in first grade retarded and non-retarded children. American Journal of Mental Deficiency, 1972, 76, 561-567.
- Bugelski, R.B. Presentation time, total time and mediation in paired-associate learning. Journal of Experimental Psychology, 1962, 63, 409-412.
- Danner, F.W., & Taylor, A.M. Integrated pictures and relational imagery training in children's learning. Journal of Experimental Child Psychology, 1973, 16, 47-54.
- Dilley, M.G., & Paivio, A. Pictures and word as stimulus and response items in paired-associate learning of young children. Journal of Experimental Child Psychology, 1968, 6, 231-240.
- Eoff, J.E., & Rohwer, W.D., Jr. A developmental study of imagery instructions in noun-pair learning. Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1972.
- Epstein, W., Rock, I., & Zuckerman, C.B. Meaning and familiarity in associative learning. Psychological Monographs, 1960, 74, (4, Whole No. 491).

- Proeberg, S. Simultaneous vs. successive association. Psychological Review, 1918, 25, 156-163.
- Guthrie, E.R. Association as a function of time interval. Psychological Review, 1933, 40, 355-367.
- Iscoe, I., & Semler, I.J. Paired-associate learning in normal and mentally retarded children as a function of four experimental conditions. Journal of Comparative and Physiological Psychology, 1964, 57, 387-392.
- Jensen, A.R. Verbal mediation and educational potential. Psychology in the Schools, 1966, 3, 99-109.
- Kerst, S., & Levin, J.R. A comparison of experimenter-provided and subject-generated strategies in children's paired-associate learning. Journal of Educational Psychology, 1973, 65, 300-303.
- Kopstein, F.F., & Roshal, S.M. Method of presenting word pairs as a factor in foreign vocabulary learning. The American Psychologist, 1955, 10, 354.
- Levin, J.R. When is a picture worth a thousand words? In Issues in imagery and learning: Four papers. Theoretical Paper No. 36. Madison: Wisconsin Research and Development Center for Cognitive Learning, 1972.
- Levin, J.R. What have we learned about maximizing what children learn? In J.R. Levin & V.L. Allen (Eds.), Cognitive learning in children: Theories and strategies. New York: Academic Press, 1976.
- Levin, J.R., Davidson, R.E., Wolff, P., & Citron, M. A comparison of induced imagery and sentence strategies in children's paired-associate learning. Journal of Educational Psychology, 1973, 64, 306-309.
- Levin, J.R., & Kaplan, S.A. Imaginal facilitation of paired-associate learning: A limited generalization? Journal of Educational Psychology, 1972, 63, 429-432.
- Martin, E. Stimulus pronunciability in aural paired-associate learning. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 18-22.
- Martin, E., & Schulz, R.W. Aural paired-associate learning: Pronunciability and the interval between stimulus and response. Journal of Verbal Learning and Verbal Behavior, 1963, 1, 389-391.

- Montague, R.B. The effect of mediational instructions on associative skills of first grade innercity children. Paper presented at the annual meeting of the American Educational Research Association, Minneapolis, March 1976.
- Mueller, D.J., & Travers, R.M.W. Temporal relations and meaningfulness in paired-associate learning. Psychological Reports, 1965, 17, 491-497.
- Mueller, D.J., Van Mondfrans, A.P., Chan, A., & Travers, R.M.W. Time relationship and transmission modality in a learning task involving word-object pairs. Perceptual and Motor Skills, 1966, 23, 615-622.
- Nodine, C.F. Temporal variables in paired-associate learning: The law of contiguity revisited. Psychological Review, 1969, 76, 351-362.
- Nodine, C.F., & Goss, A.E. Temporal parameters in paired-associate learning. Psychonomic Monograph Supplements, 1969, 3 (1, Whole No.33).
- Paivio, A. Mental imagery in associative learning and memory. Psychological Review, 1969, 76, 241-263.
- Paivio, A. On the functional significance of imagery. Psychological Bulletin, 1970, 73, 385-392.
- Paivio, A. Imagery and verbal processes. New York: Holt, Rinehart and Winston, 1971.
- Piaget, J., & Inhelder, B. Mental imagery in the child. New York: Basic Books, 1971.
- Reese, H.W. Imagery and contextual meaning. Psychological Bulletin, 1970, 73, 404-414.
- Reese, H.W. Cohort, age, and imagery in children's paired-associate learning. Child Development, 1974, 45, 1176-1178.
- Rohwer, W.D., Jr. Social class differences in the role of linguistic structures in paired-associate learning: Elaboration and learning proficiency. Final report on basic research Project No. 5-0605, U.S. Office of Education, 1967.

- Rohwer, W.D., Jr. Mental mnemonics in early learning. The Record - Teachers College, 1968, 70, 213-226.
- Rohwer, W.D., Jr. Images and pictures in children's learning: Research results and educational implications. Psychological Bulletin, 1970, 73, 393-403.
- Rohwer, W.D., Jr., & Ammon, M.S. Locus of facilitation in noun-pair learning. Paper presented at the annual meeting of the Western Psychological Association, San Diego, 1968.
- Rohwer, W.D., & Ammon, M.S. Elaboration training and paired-associate learning efficiency in children. Journal of Educational Psychology, 1971, 62, 376-383.
- Rohwer, W.D., Jr., Ammon, M.S., & Levin, J.R. Learning efficiency and elaboration training among four and five-year-old children. In W.D. Rohwer, Jr. & P.R. Ammon, The assessment and improvement of learning and language skills in four and five year old culturally disadvantaged children. Final report OEO Contract No. B99-4776, Washington, D.C.: Office of Economic Opportunity, June 1971.
- Rohwer, W.D., Jr., Ammon, M.S., Suzuki, N., & Levin, J.R. Population differences and learning proficiency. Journal of Educational Psychology, 1971, 62, 1-14.
- Rohwer, W.D., Jr., Kee, D.W., & Guy, K.C. Developmental changes in the effects of presentation media on noun-pair learning. Journal of Experimental Child Psychology, 1975, 19, 137-152.
- Rohwer, W.D., Jr., & Levin, J.R. Elaboration preferences and differences in learning proficiency. In J. Hellmuth (Ed.), Cognitive Studies. Vol. 2. New York: Brunner/Mazel, 1971.
- Rohwer, W.D., Jr., Lynch, S., Levin, J.R., & Suzuki, N. Pictorial and verbal factors in the efficient learning of paired associates. Journal of Educational Psychology, 1967, 58, 278-284.
- Semler, I.J., & Iscoe, I. Comparative and developmental study of the learning abilities of Negro and white children under four conditions. Journal of Educational Psychology, 1963, 54, 38-44.

- Semler, I.J., & Iscoe, I. Structure of intelligence in Negro and white children. Journal of Educational Psychology, 1966, 57, 326-336.
- Stubin, E.J., Heimer, W.I., & Tatz, S.J. Total time and presentation time in paired-associate learning. Journal of Experimental Psychology, 1970, 84, 308-310.
- Van Mondfrans, A.P., & Travers, R.M.W. Paired-associate learning within and across sense modalities and involving simultaneous and sequential presentations. American Educational Research Journal, 1965, 2, 89-99.
- Varley, W.H., Levin, J.R., Severson, R.A., & Wolff, P. Training imagery production in young children through motor involvement. Journal of Educational Psychology, 1974, 66, 262-266.
- Wolff, P., & Levin, J.R. The role of overt activity in children's imagery production. Child Development, 1972, 43, 537-547.
- Wolff, P., & Levin, J.R., & Longobardi, E.T. Activity and children's learning. Child Development, 1974, 45, 221-223.
- Wolff, P., Levin, J.R., & Longobardi, E.T. Motoric mediation in children's paired-associate learning: Effects of visual and tactual contact. Journal of Experimental Child Psychology, 1972, 14, 176-183.
- Yuille, J.C., & Catchpole, M.J. Associative learning and imagery training in children. Journal of Experimental Child Psychology, 1973, 16, 403-412.
- Yuille, J.C., & Paivio, A. Imagery and verbal mediation instructions in paired-associate learning. Journal of Experimental Psychology, 1961, 71, 436-441.

Appendix A
Sample Scoring Sheet

60

SUBJECT: _____ M F CONDITION: _____
BIRTHDATE: _____ C.A. _____ POPULATION: _____

Training Pairs

- | | |
|--------------------------|--------------------------------|
| 1. SPIDER chasing MOTHER | 5. HAMMER hitting BLOCK |
| 2. GIRL blowing WHISTLE | 6. PIG rolling BALL |
| 3. TRUCK carrying BOTTLE | 7. DUCK smoking PIPE |
| 4. BRUSH cleaning MOUSE | 8. SAFETY PIN sticking FIREHAT |

Criterion List

Criterion List	Response	Score
1. TELEPHONE (BABY)	_____	_____
2. GUN (CLOWN)	_____	_____
3. HORSE (SCISSORS)	_____	_____
4. GUITAR (MONKEY)	_____	_____
5. COWBOY (CAR)	_____	_____
6. LAMP (BOAT)	_____	_____
7. COFFEE POT (LION)	_____	_____
8. WRISTWATCH (GIRAFFE)	_____	_____
9. UMBRELLA (BICYCLE)	_____	_____
10. TURTLE (CUP)	_____	_____
11. FORK (AIRPLANE)	_____	_____
12. STOVE (SCREWDRIVER)	_____	_____
13. CRAYON (PURSE)	_____	_____
14. POLICEMAN (TABLE)	_____	_____
15. TEDDY BEAR (PLATE)	_____	_____

Total Correct: _____

Appendix B
Transcripts of Instructions

Control - Simultaneous Pictures

"Hi! How are you today? I'm going to show you some pictures two at a time, like this. (experimenter presents first training pair). Now look at this drawing. (experimenter presents example drawing for first training pair). See, it looks like this one is chasing the other one. (experimenter allows subject to view drawing for 5 or 6 seconds, returns first training pair and example drawing to box and presents second training pair). Now look at these things. (experimenter presents example drawing for second training pair). Here it looks like she picked up this thing and is blowing on it real hard. (experimenter removes training pair and drawing and presents third training pair). Now look at these things. (experimenter presents example drawing for third training pair). Here it looks like this thing loaded this in here and is driving it around. (experimenter removes training pair and drawing and presents fourth training pair). Now look at these things. (experimenter shows example drawing for fourth training pair). Here it looks like this thing is cleaning him off. It can clean his whiskers and his tail. (experimenter then removes

fourth training pair and drawing and says to subject,)
 You paid attention real well. Did you enjoy that? Good.
 Now let's do something different. I'm going to show you
 some more things two at a time, but this time I'm not
 going to show you drawings like I did with the others.
 As I show you these things, I want you to think of a picture
 of the two things doing something together. Do you under-
 stand? Fine. Just think of a picture of the things doing
 something together." (experimenter presents each of the
 remaining four training pairs to subject for 10 seconds. As
 each pair is shown, experimenter will say to subject,)
 Think of a picture of the things doing something together.
 (After the last training pair is exposed to subject,
 experimenter will give the instructions for the criterion
 learning task)

Criterion - List Instructions:

"Now I'm going to show you some more things two at a time
 and you are to remember which things go together. As I
 show you the things, think of a picture of the things
 doing something together, just like you did with the ones
 I just showed you."

(As each pair is presented, experimenter will say,)"Think
 of a picture of the things doing something together."

Training - Simultaneous Pictures

"Hi! Do you like to draw? Fine. (experimenter will show
 first training pair). Here are two pictures, and here is

a pencil and a piece of paper. Now, can you make a drawing of these two things doing something together? (experimenter will interpret subject's drawing, but will not label the toys). That's a very good drawing! It looks like she's stepping on him, right?

(When subject has trouble drawing a recognizable interaction, experimenter will present an example drawing of that pair and say,) Here is a drawing of these two things doing something together. See, he is chasing her. Now let's see what you can do with them.

(If subject's performance is not improved with the aid of an example drawing on each pair, experimenter will give subject a verbal suggestion saying,) That's not bad, but I still can't tell what the things are doing in your picture. Maybe if you drew them touching each other, I'd be able to see what's happening too.

(Experimenter will remove first training pair and subject's drawing from the table and will present the second training pair. The above sequence will be continued for the first four training pairs.

(After the fourth training pair, experimenter will give subject instructions which will require him to generate an imaginal interaction first, and then execute it through drawing. The instructions will be as follows:) You sure made some nice drawings of those things doing things

together. Now let's try something different. I'm going to show you two pictures, but this time, instead of drawing them doing something together, just think up a picture you could draw of the things doing something together. (subject will be given a sheet of paper and a pencil, and the fifth training pair will be presented). Don't move your pencil. Just think of a picture you could draw of these things doing something together. Raise your hand as soon as you think of a picture you could draw of the things doing something together. (Upon a cue from subject, or at the end of 10 seconds, experimenter will ask subject,) Have you thought of a picture you could draw of them? Good! Now, show me what you thought up by drawing the things.

(Subjects who cannot comply with instructions to generate an imaginal interaction before drawing will be allowed to draw the toys in hopes that the act of drawing will evoke an idea. If subject still has trouble, experimenter will offer subject a suggestion).

(Before each of the last three training pairs, subjects will be told,) Think up a picture you could draw of these two things doing something together. Raise your hand as soon as you get an idea."

Criterion - List Instructions:

"Now let's play a game. I am going to show you some more pictures and you are to remember which things go together.

As I show you the pictures, think up a picture you could draw of the things doing something together, just like you did for the ones I just showed you.

(As each pair is presented experimenter will say to subject,) Think up a picture you could draw of these things doing something together."

Control - Successive Pictures

"Hi! How are you today? I'm going to show you some pictures one after the other, like this. (experimenter presents first training pair). Now look at this drawing. (experimenter presents example drawing for first training pair). See, it looks like this one is chasing the other one. (experimenter allows subject to view drawing for 5 Or 6 seconds, returns first training pair and example drawing to box and presents second training pair). Now look at these things. (experimenter presents example drawing for second training pair). Here it looks like she picked up this thing and is blowing on it real hard. (experimenter removes training pair and drawing and presents third training pair). Now look at these things. (experimenter presents example drawing for third training pair). Here it looks like this thing loaded this in here and is driving it around. (experimenter removes training pair and drawing and presents fourth training pair). Now look at these things. (experimenter shows example for fourth training pair). Here it looks like this thing is

cleaning him off. It can clean his whiskers and his tail.
(experimenter then removes fourth training pair and drawing and says to subject,) You paid attention real well. Did you enjoy that? Good. Now let's do something different. I'm going to show you some more things one after the other, but this time I'm not going to show you drawings like I did with the others. As I show you these things, I want you to think of a picture of the two things doing something together. Do you understand? Fine. Just think of a picture of the things doing something together.
(Experimenter presents each of the remaining four training pairs to subject for 10 seconds. As each pair is shown, experimenter will say to subject,) Think of a picture of the things doing something together."
(After the last training pair is exposed to subject, experimenter will give the instruction for the criterion learning task).

Criterion - List Instructions:

"Now I'm going to show you some more things one after the other and you are to remember which things go together. As I show you the things, think of a picture of the things doing something together, just like you did with the ones I just showed you.

(As each pair is presented, experimenter will say,) Think of a picture of the things doing something together."

Training - Successive Pictures

"Hi! Do you like to draw? Fine. I'm going to show you some pictures, one after the other, like this. (experimenter presents first training pair and gives subject a pencil and a piece of paper). Now, can you make a drawing of those two things doing something together? (experimenter will interpret the subject's drawing, but will not label the objects). That's a very good drawing! It looks like she's stepping on him, right? (When a subject has trouble drawing a recognizable interaction, the experimenter will present an example drawing of that pair and say, Here is a drawing of those two things doing something together. See, he is chasing her. Now let's see what you can do with them. If a subjects's performance is not improved with the aid of an example drawing on each pair, the experimenter will give the subject a verbal suggestion, saying) That's not bad, but I still can't tell what the things are doing in your picture. Maybe if you drew them touching each other, I'd be able to see what's happening too. (experimenter will remove example drawing and present second training pair saying,) Now look at these things. Now, can you make a drawing of those two things doing something together? (the above sequence will be continued for the first four training pairs).

(After the fourth training pair, experimenter will give

subject instructions which will require him to generate an imaginal interaction first, and then execute it through drawing. The instructions will be as follows:) You sure made some nice drawings of those things doing things together. Now let's try something different. I'm going to show you some more pictures, one after the other, but this time, instead of drawing them doing something together, just think up a picture you could draw of the things doing something together. (subject will be handed a sheet of paper and a pencil and experimenter will present the fifth training pair saying,) Now look at these things. Don't move your pencil. Just think of a picture you could draw of those things doing something together. Raise your hand as soon as you think of a picture you could draw of the things doing something together. (Upon a cue from subject, or at the end of 10 seconds, experimenter will ask subject,) Have you thought of a picture you could draw of them? Good! Now, show me what you thought up by drawing the things." (Subjects who cannot comply with instructions to generate an imaginal interaction before drawing will be allowed to draw the toys in hopes that the act of drawing will evoke an idea. If subject still has trouble, experimenter will offer a subject a suggestion).

(Before each of the last three training pairs, subjects will be told,) Think up a picture you could draw of these two

things doing something together. Raise your hand as soon as you get an idea."

Criterion List Instructions:

"Now let's play a game. I am going to show you some more things are you are to remember which things go together. As I show you the things, think up a picture you could draw of the things doing something together, just like you did for the ones I just showed you. (As each pair is presented experimenter will say to subject,) Think up a picture you could draw of these things doing something together."

Control - Successive Nouns

"Hi! How are you today? I'm going to name some things, one after the other, like this. (experimenter presents first training pair) Now look at this drawing. (experimenter presents example drawing for first training pair) See, it looks like this one is chasing the other one.

(experimenter allows subject to view drawing for 5 or 6 seconds, returns drawing to box and presents second training pair, saying) Now listen, (experimenter presents example drawing for second pair) Here it looks like she picked up this thing and is blowing on it real hard.

(experimenter removes drawing and presents third training pair saying,) Now listen again, (experimenter presents example drawing for third training pair) Here it looks like

this thing loaded this in here and is driving it all around (experimenter removes drawing and presents fourth training pair) Listen again, (experimenter shows example drawing for fourth training pair) Here it looks like this thing is cleaning him off. It can clean his whiskers and his tail. (experimenter then removes drawing and says to subject,) You paid attention real well. Did you enjoy that? Good. Now let's do something different. I'm going to name some more things, one after the other, but this time I'm not going to show you drawings like I did with the others. As I name the things I want you to think of a picture of the two things doing something together. Do you understand? Fine. Just think of a picture of the things doing something together. (experimenter presents each of the remaining four pairs at subject at a 10 second rate; as each pair is presented, experimenter will say to subject,) Think of a picture of the things doing something together." (After the last training pair is presented, experimenter will give the instructions for the criterion learning task) Criterion List Instructions:

"Now I'm going to name some more things, one after the other, and you are to remember which things go together. As I name the things think of a picture of the things doing something together, just like you did with the ones I just told you. (as each pair is presented, experimenter will

say,) Think of a picture of the things doing something together."

Training - Successive Nouns

"Hi! Do you like to draw? Fine. I'm going to name some things, one after the other, like this. (experimenter presents first training pair and gives subject a pencil and a piece of paper). Now, can you make a drawing of those two things doing something together? (experimenter will interpret subject's drawing, but will not label the toys). That's a very good drawing! It looks like she's stepping on him, right? (When subject has trouble drawing a recognizable interaction, experimenter will present an example drawing of that pair and say,) Here is a drawing of those two things doing something together. See, he is chasing her. Now let's see what you can do with them. (If subject's performance is not improved with the aid of an example drawing on each pair, experimenter will give subject a verbal suggestion, saying,) That's not bad, but I still can't tell what the things are doing in your picture. Maybe if you drew them touching each other, I'd be able to see what's happening too. (experimenter will remove example drawing and present second training pair saying,) Now listen again. Now, can you make a drawing of those two things doing something together? (The above sequence will be continued for the first four training pairs).

(After the fourth training pair, experimenter will give subject instructions which will require him to generate an imaginal interaction first, and then execute it through drawing. The instructions will be as follows:) You sure made some nice drawings of those things doing things together. Now let's try something different. I'm going to name some more things, one after the other, but this time, instead of drawing them doing something together, just think up a picture you could draw of the things doing something together. (subject will be handed a sheet of paper and a pencil and experimenter will present the fifth training pair saying,) Now listen. Don't move your pencil. Just think of a picture you could draw of those things doing something together. Raise your hand as soon as you think of a picture you could draw of the things doing something together. (Upon a cue from subject, or at the end of 10 seconds, experimenter will ask subject,) Have you thought of a picture you could draw of them? Good! Now, show me what you thought up by drawing the things. (subjects who cannot comply with instructions to generate an imaginal interaction before drawing will be allowed to draw the toys in hopes that the act of drawing will evoke an idea. If subject still has trouble, experimenter will offer subject a suggestion). (Before each of the last three training pairs, subjects will be told,) think

up a picture you could draw of these two things doing something together. Raise your hand as soon as you get an idea."

Criterion - List Instructions

"Now let's play a game. I am going to name some more things and you are to remember which things go together. As I name the things, think up a picture you could draw of the things doing something together, just like you did for the ones I just told you. (As each pair is presented experimenter will say to subject,) Think up a picture you could draw of these things doing something together."

Appendix C

Raw Data by Socioeconomic Levels and Conditions

Level	Conditions					
	Drawing Training			Imagery Control		
	SiP	SuP	SuN	SiP	SuP	SuN
Middle	10	10	2	10	4	7
	15	2	4	10	0	3
	4	9	0	12	3	4
	4	2	11	12	6	0
	11	4	5	11	4	1
	13	1	12	9	4	10
	12	4	10	13	2	0
Lower	3	1	0	10	0	0
	6	2	5	6	2	0
	0	3	0	13	4	1
	5	4	1	11	0	2
	11	10	0	5	2	8
	10	0	8	5	1	1
	5	1	4	11	5	6

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